CHUCK ASSEMBLY OF ETCHING APPARATUS FOR PREVENTING BYPRODUCTS

Cross-Reference to Related Application

This application is based on Korean Patent Application No. 2001-44892 filed on July 25, 2001.

Background

1. Technical Field:

The present invention relates to an etching apparatus of a semiconductor device, and more particularly, to an etching apparatus comprising a chuck assembly for preventing byproducts being formed along an edge portion of a wafer, thereby improving a production yield of a semiconductor device.

2. Description of Related Art:

Generally, an etching process of semiconductor devices, for example, a plasma etching process, is performed to etch a certain portion of a wafer exposed by a photo-resist patterning process. Typically, a plasma etching process comprises supplying a process gas on a wafer positioned between upper and lower electrodes, and then applying high frequency power to charge the process gas to a plasma state. The plasma then reacts with the portion of the wafer exposed during a photo-resist patterning process. It is required that the plasma-state gas uniformly reacts with the entire surface of the wafer.

FIG. 1 is a sectional view of a chuck assembly of a conventional etching apparatus, and FIG. 2 is an enlarged sectional view of the portion II in FIG. 1. Referring to FIG. 1, a chuck assembly comprises a main body 12 for supporting a central portion of a wafer W except an edge portion of the wafer W. An edge ring 14 is provided on an edge portion of the chuck main body 12. The edge ring 14 comprises a stepped portion and is made of similar silicon material as the wafer W. High frequency power is applied to an upper electrode 10 of the wafer W.

An inner side portion of the edge ring 14, as shown in FIGS. 1 and 2, comprises a step shape having a predetermined thickness for supporting the edge portion of the wafer W exposed by the step edge portion of the chuck main body 12. The bottom portion of the edge ring 14 is extended to the edge portion of the chuck body 12 and is supported by an insulating ring 16 fixed to a side wall of the chuck body 12.

When an etching process is performed with the conventional chuck assembly, the edge ring 14 serves to distribute a plasma gas up to the edge portion of the wafer W in response to the high-frequency power applied to the upper electrode 10 of the wafer W. Thus, the plasma gas affects the entire surface of the wafer W. However, a slanted portion B at the edge side portion of the wafer W cannot be sufficiently etched to a desired thickness during the etching process. As a result, residual byproducts of a cone shape remain at the slanted portion B of the wafer W. As shown in FIG. 3, these cone shaped residuals form a flow shaped pattern at a flat portion F on an inferior wafer along the edge portion of the wafer W during a following process, thereby decreasing a production yield and productivity thereof.

Summary of the Invention

To solve the problem, it is an object of the present invention to provide an etching apparatus comprising a chuck assembly capable of improving an etching rate at an edge portion of a wafer, thereby preventing byproducts from being formed along the edge portion of the wafer.

According to an aspect of the present invention, a chuck assembly of an etching apparatus is provided. The chuck assembly comprises a chuck body comprising a stepped portion at an edge side portion of the chuck body, for supporting a central portion of a wafer; an edge ring, received in the stepped portion of the chuck body, for supporting an edge portion of the wafer, wherein the edge ring has less resistance than the resistance of the wafer; and an insulating ring provided at a surrounding portion of the chuck body, for supporting a bottom portion of the edge ring, the bottom portion of the edge ring being extended toward outside of the chuck body.

The difference in the resistance between the edge ring and the wafer is preferably about 0.005 to about 4.5 Ω. For example, the resistance of the edge ring is about 3.5 to about 1.5 Ω. The edge ring preferably comprises a slanted step portion whose surface forms an angle of about 40 to about 80 degrees relative to a normal to the wafer surface. The slanted step portion of the edge ring begins from about 1.5 to about 4.5 mm, more preferably, about 1.5 to about 2.5 mm from the edge portion of the wafer.

According to another aspect of the present invention, a chuck assembly for a semiconductor etching apparatus is provided. The chuck assembly comprises a chuck body for supporting a semiconductor wafer; an edge ring, disposed on the chuck body, for supporting an edge portion of the wafer; an insulating ring, disposed on the outside

portion of the chuck body, for supporting the edge ring; wherein the electrical resistance of the edge ring is less than the electrical resistance of the wafer so as to uniformly etch the portion of the wafer supported by the edge ring during an etch process.

Brief Description of the Drawings

The foregoing and other objects, aspects and advantages will be better understood from the following detailed description of preferred embodiments of the invention with reference to the drawings, in which;

FIG. 1 is a sectional view showing a chuck assembly of a conventional etching apparatus;

FIG. 2 is an enlarged sectional view of the portion II of the chuck assembly of FIG. 1;

FIG. 3 is a plane view illustrating cone shaped residuals remained on a wafer in using the chuck assembly of FIG. 1 to etch the wafer; and

FIG. 4 is a partial sectional view illustrating a chuck assembly of an etching apparatus according to an embodiment of the present invention.

Detailed Description of Preferred Embodiments

Herein after, the present invention will be described in detail with reference to the accompanying drawings. It should be noted that similar reference numerals are used in the accompanying drawings to designate similar or equivalent parts or portions. Further, although exemplary specifications will be provided in the following discussion to provide a thorough understanding of the present invention, it is to be understood by

those one skilled in the art that the present invention can be achieved without such specifications. A detailed description of well-known functions and structures will be omitted so as to clarify key points of the present invention.

FIG. 4 is a partial sectional view illustrating a chuck assembly of an etching apparatus according to an embodiment of the present invention. Advantageously, a chuck assembly according to an embodiment of the present invention improves an accuracy of etching at an edge portion of a wafer and enables high frequency to be uniformly distributed over the wafer.

As shown in FIG. 4, a chuck assembly according to an embodiment of the present invention comprises a chuck body 12 for supporting a center portion of a wafer W (except an edge portion of the wafer W). An edge ring 20, which is formed in a stepped portion in the edge portion of the chuck body 12, supports an edge portion of the wafer W. An insulating ring (see, 16 in FIG. 1) is provided at a surrounding portion of the chuck body 12 for supporting a bottom portion of the edge ring 20 extended toward outside of the chuck body 12. The edge ring 20 is supported by the stepped portion of the chuck body 12 and the edge ring 20 comprises a stepped portion at an inner side portion thereof.

Preferably, the edge ring 20 has less electrical resistance than the electrical resistance of the wafer W such that the difference in the resistance between the edge ring 20 and the wafer W is less than about 0.005 to about 4.5Ω. For instance, if the edge ring 20 has resistance of about 1.5 to about 3.5Ω, the wafer W preferably has resistance of about 5Ω.

Advantageously, since the edge ring 20 has less resistance than the resistance of the wafer W, high frequency power is evenly activated at the edge portion of the wafer W (that is placed on the edge ring 20 and the stepped portion of the chuck body 12), thereby effectively etching a slant portion (see, B in FIG. 2) at the edge portion of the wafer W and preventing cone shaped residuals from remaining along the edge portion of the wafer W.

Referring back to FIG. 2, surface "A" between an upper portion P' and lower portion P of the inner side portion of the edge ring 14 is slanted at an angle (□) of about 15 degrees with respect to a vertical line (which, as shown, is a normal to surface of the wafer). In other words, because the upper portion P' has an acute angle to the normal, i.e., keen-edged, the upper portion P' serves to concentrate the plasma effect of high frequency power on undesired portions, thereby decreasing the etch rate at the edge portion of the wafer W.

In contrast, the structure of the edge ring 20 according to an embodiment of the present invention, as shown in FIG. 4, comprises a surface "a" between an upper portion p' and a lower portion p at an inner stepped portion of the edge ring 20. The surface "a" is gently slanted with a normal in an angle (□') of about 40 to about 80 degrees, relative to a normal to the wafer surface.

Further, the lower portion p of the edge ring 20 according to an embodiment of the present invention has a longer distance l from the edge portion of the wafer W than a distance L of the lower portion P of the edge ring 14 as shown in FIG. 2. The distance l may have a range of about 1.5 to about 4.5 mm, more preferably a range of about 1.5 to about 2.5 mm.

With a chuck assembly of an etching apparatus according to an embodiment of the present invention, high frequency power that is applied to a wafer during an etching process effectively and uniformly distributes a plasma gas over a wafer such that an exposed portion of the wafer is accurately and evenly etched by the plasma gas, thereby preventing the formation of cone-shaped residuals along an edge portion of the wafer.

While the invention has been described in terms of preferred embodiments, those skilled in the art will recognize that the invention can be practiced with modification within the sprit and scope of the appended claims.